

What is claimed is:

1. A wiring structure of a semiconductor device, comprising:
a first insulating film having plural grooves formed thereon, which has an interface in the horizontal direction between the adjoining grooves;
plural wiring films formed to protrude from the interface, each by the grooves of the first insulating film;
plural barrier films, formed on bottoms of the wiring films, which are formed on side faces of the wiring films to a height exceeding the interface; and
plural cap films formed at least on upper faces of the wiring films, which are separated each by the grooves.
2. A wiring structure of a semiconductor device as claimed in Claim 1, wherein the cap films are formed on parts protruding from the interface from the upper faces of the wiring films till the interface of the first insulating film, and are separated on the interface.
3. A wiring structure of a semiconductor device as claimed in Claim 2, wherein the cap films are formed only on the upper faces of the wiring films and the barrier films.
4. A wiring structure of a semiconductor device as claimed in Claim 2, wherein the cap films are an insulating film containing Si_xN_y , Si_xC_y , $\text{Si}_x\text{O}_y\text{N}_z$, or Si_xC_y as a principal composition.
5. A wiring structure of a semiconductor device as claimed in Claim 2, wherein the cap films are a metal film made of Ta_xN_y , Ta, or $\text{Ta}_x\text{Si}_y\text{N}_z$.
6. A wiring structure of a semiconductor device as claimed in Claim 2, wherein the cap films are a metal film made of Ti_xN_y or $\text{Ti}_x\text{Si}_y\text{N}_z$.
7. A wiring structure of a semiconductor device as claimed in Claim 2, wherein the cap films are a metal film made of W_xN_y or $\text{W}_x\text{Si}_y\text{N}_z$.
8. A wiring structure of a semiconductor device as claimed in Claim 1, wherein the cap films are formed selectively on parts of the wiring films and the barrier films, protruding from the interface.

9. A wiring structure of a semiconductor device as claimed in Claim 1, wherein the cap films are a metal film containing tungsten W as a principal composition.

10. A wiring structure of a semiconductor device as claimed in Claim 1, wherein the first insulating film has plural protrusions protruding from the interface, and the grooves are formed in the protrusions.

11. A wiring structure of a semiconductor device as claimed in Claim 10, wherein the upper faces of the wiring films and the barrier films are substantially coincident with upper ends of the grooves.

12. A wiring structure of a semiconductor device as claimed in Claim 11, wherein the protrusions are formed through etching the first insulating film, using the cap films as a mask, and the upper faces of the cap films have substantially the same shape with the upper faces of the protrusions.

13. A wiring structure of a semiconductor device as claimed in Claim 12, wherein the cap films are a metal film made of Ta_xN_y , Ta, or $Ta_xSi_yN_z$.

14. A wiring structure of a semiconductor device as claimed in Claim 12, wherein the cap films are a metal film made of Ti_xN_y or $Ti_xSi_yN_z$.

15. A wiring structure of a semiconductor device as claimed in Claim 12, wherein the cap films are a metal film made of W_xN_y or $W_xSi_yN_z$.

16. A wiring structure of a semiconductor device as claimed in Claim 12, wherein the cap films are an insulating film containing Si_xN_y , $Si_xO_yN_z$, Si_xC_y , or Si_xC_y as a principal composition.

17. A method of manufacturing a wiring structure of a semiconductor device, comprising the steps of:

forming plural grooves on a first insulating film;

forming barrier films and wiring films in order on the first insulating film;

flattening the wiring films and the barrier films until the first insulating film is exposed, and leaving the wiring films and the barrier films only in the grooves;

thinning the first insulating film, and protruding the wiring films and the barrier films from an interface of the first insulating film; and

after thinning the first insulating film, forming cap films separated each by the grooves.

18. A method of manufacturing a wiring structure of a semiconductor device, as claimed in Claim 17, wherein the step of flattening the wiring films and the barrier films comprises the steps of:

polishing the wiring films, using the barrier films as a stopper; and

polishing the wiring films and the barrier films, using the first insulating film as a stopper.

19. A method of manufacturing a wiring structure of a semiconductor device, as claimed in Claim 17, wherein the step of forming the cap films comprises the steps of:

after thinning the first insulating film, forming the cap films on a whole surface; and

removing part of the cap films between the grooves to separate the cap films each by the grooves.

20. A method of manufacturing a wiring structure of a semiconductor device, as claimed in Claim 17, wherein the step of forming the cap films forms the cap films selectively on parts of the wiring films and the barrier films, protruding from the interface, to form the cap films separated each by the grooves.

21. A method of manufacturing a wiring structure of a semiconductor device, as claimed in Claim 20, wherein the cap films are made of tungsten W.

22. A method of manufacturing a wiring structure of a semiconductor device, comprising the steps of:

forming plural grooves on a first insulating film;

forming barrier films and wiring films in order on the first insulating film;

flattening the wiring films and the barrier films until the first insulating

film is exposed, and leaving the wiring films and the barrier films only in the grooves;

after flattening the wiring films and the barrier films, forming cap films on a whole surface;

removing the cap films so as to leave the cap films at least on the wiring films and the barrier films; and

thinning the first insulating film in parts having the cap films removed, and protruding the wiring films and the barrier films from an interface of the first insulating film of the thinned parts.

23. A method of manufacturing a wiring structure of a semiconductor device, as claimed in Claim 22, wherein the step of removing the cap films removes the cap films so as to leave the cap films only on the wiring films and the barrier films.

24. A method of manufacturing a wiring structure of a semiconductor device, as claimed in Claim 22, wherein the step of flattening the wiring films and the barrier films comprises the steps of:

polishing the wiring films, using the barrier films as a stopper; and

polishing the wiring films and the barrier films, using the first insulating film as a stopper.

25. A method of manufacturing a wiring structure of a semiconductor device, as claimed in Claim 22, wherein the step of thinning the first insulating film processes the first insulating film, using at least the cap films left on the wiring films and the barrier films as a mask.

26. A wiring structure of a semiconductor device, comprising:

a first insulating film having plural protrusions in which grooves are formed, which has an interface in the horizontal direction between the adjoining protrusions;

plural wiring films embedded in the grooves through barrier films;

plural first cap films formed on upper faces of the protrusions; and

second cap films formed on the first cap films and the first insulating film.

27. A wiring structure of a semiconductor device as claimed in Claim 26, wherein the upper faces of the wiring films and the barrier films are substantially coincident with upper ends of the grooves.

28. A wiring structure of a semiconductor device as claimed in Claim 26, wherein the protrusions are formed through etching the first insulating film, using the first cap films as a mask, and the upper faces of the first cap films have substantially the same shape with the upper faces of the protrusions.

29. A wiring structure of a semiconductor device as claimed in Claim 28, wherein the first cap films are a metal film made of Ta_xN_y , Ta, or $Ta_xSi_yN_z$.

30. A wiring structure of a semiconductor device as claimed in Claim 28, wherein the first cap films are a metal film made of Ti_xN_y or $Ti_xSi_yN_z$.

31. A wiring structure of a semiconductor device as claimed in Claim 28, wherein the first cap films are a metal film made of W_xN_y or $W_xSi_yN_z$.

32. A wiring structure of a semiconductor device as claimed in Claim 28, wherein the second cap films are an insulating film containing Si_xN_y , $Si_xO_yN_z$, Si_xC_y , or Si_xC_y as a principal composition.